

THE RELATIONS OF THE GROSS ANATOMY OF
THE VERMIFORM APPENDIX TO SOME
FEATURES OF THE CLINICAL HIS-
TORY OF APPENDICITIS.

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THE abstract anatomy of any part of the human body is practically of as little use to a physician and surgeon as are bricks and mortar to a builder when considered independently of each other for building purposes. While the study of anatomy is both interesting and instructive to the practical physician and surgeon, even when disassociated with its applied utility, still it becomes doubly so when the anatomical facts are taught as aids in diagnosis and treatment. I intend no disrespect to a branch of medical study with which I have been long associated, when I say "that a knowledge of anatomy is of but little use to the physician or surgeon except in its relations to the pathology, clinical history and treatment of disease and injury; and, furthermore, is taught best in connection with them." I approach the consideration of this paper's title thus indirectly in order that I may here express my opposition to the plan of teaching abstract anatomy only, and urge its presentation on the practical basis mainly, since the chief benefits are derived from its practical, or applied, use in medicine and surgery. It is my purpose to-night to demonstrate especially the important relations between the clinical histories of cases of appendicitis in many respects, and the varying anatomical arrangements of the vermiform appendix itself. Several years ago I requested Dr. H. M. Biggs, then, as now, a curator at Bellevue Hospital, to collect for me the following data regarding the relations of the vermiform appendix and its associated tissues, and also to note the presence of any

change in its contents, size, etc., which might appear in the cases coming under his observation in autopsies made for other reasons than diseases of this appendage. Dr. Biggs was requested to note the age and sex of the subjects, together with the length, diameter, contents, direction and position of the appendix, and the characteristics of its mesentery. Several months ago Dr. Biggs kindly handed me a list of the facts as developed by the examinations in 150 autopsies. In 131 of the 150 cases ninety were males, forty-one females, and in nineteen the sex was not stated.

Length of the Appendix.—The average length of the appendix in the male cases was three and five-tenths inches; in the female, three and one-tenth inches; in those in which the sex is not stated, two and three-fourths inches. It appears, therefore, from these cases, that the appendix of the male is four-tenths of an inch longer than that of the female. The extremes of the male series (90) were respectively eight inches and one-quarter of an inch in length, there being but one of each of these. Four were found between one-half and one inch in length, seven between one inch and one inch and a half in length. About fifty per cent. of the male series (90) were from four to six inches in length. The extremes of the female series (41) were seven inches and one inch in length, there being but one of each of these. In no instance in this series of cases (144) has there been noticed an appendix of the extraordinary length sometimes recorded.

Origin of the Appendix.—It is interesting to note the differences in the origin of the appendix from the cæcum. In the cases on which this estimate is made, the ilco-cæcal valve, or practically the implantation of the small into the large intestine, is taken as the point of departure. In forty-seven (56 per cent.) of a series of eighty-two male cases, the appendix arose one inch below the valve and posteriorly. It arose three-fourths of an inch below the valve and posteriorly in ten instances; one and a half inches below the valve and posteriorly in seven instances; one inch below and back of the valve in five cases; just below in one; one and a half inches below in six; external to the meso-colon in one; one inch external to the valve in two; from the apex of the cæcum in one. Other points of origin were noted by

Dr. Biggs, but since they are slight modifications only of those already mentioned, they are not deemed of sufficient significance in this respect to entitle them to separate mention. Thirty-five of the female subjects showed that forty per cent. (14) arose one inch below the valve; in seven instances, three-fourths of an inch below; in three instances, one and one-half inch below; in three instances, one-half inch below; and in one case from the apex of



FIG. 1. POSTERIOR VIEW.—Showing ilium coming out of pelvis, passing in front of a large appendix, which turns to the left in a hooked manner, held in position by a short mesentery. Appendix continuous with the end of an insignificant cæcum.

the cæcum itself, the same as in the male series. It arose also in two additional instances behind and immediately below the valve. It is not necessary to use further words in this connection, as sufficient information is already revealed to demonstrate substantially that in one-half of the cases of both sexes the established point of origin of the vermiform appendix is one inch below the valve, and on the posterior surface of the cæcum. It is interest-

ing also to note that forty per cent. (34) of the remaining male series are not at a greater distance from the valve than one and a half inches. It follows, therefore, that finger-point pressure, when directed from without, will invade the origin of the vermiform from the cæcum in not less than ninety-six per cent. of all male cases. An examination of the data bearing on this point, referable to the female sex, exhibits no material difference in this regard. Curious instances of origin of the appendix are noted, as in one of the male series it arose external to the meso-colon, and in one each of both sexes it arose from the apex of the cæcum. (See illustrations).

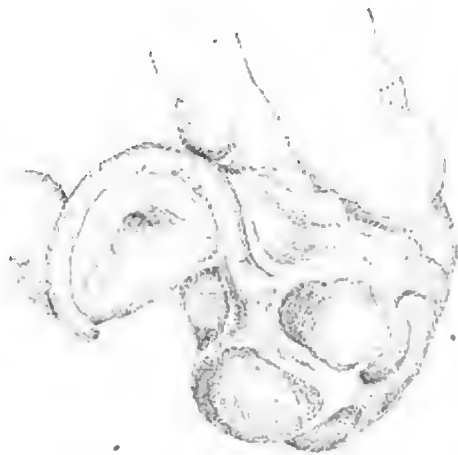


FIG. 2. POSTERIOR VIEW.—Showing appendix confined in position by short mesentery and lying behind the ilium. The relations of the origin of the appendix and the ilium with cæcum substantially normal. All of the appendix except the origin and termination inclosed between the layers of the iliac mesentery.

Diameter of the Appendix.—The stereotyped expression employed in anatomical works, characterizes the diameter of the appendix as about that of a "crow's quill." The exact average diameter in a considerable number of cases is not devoid of interest, since it bears on the importance of any unusual increase in size that may appear. The comparative diameter of the vermi-

form appendix as bearing on the sex in these cases, shows that the appendix of the male averages about one-tenth of an inch in diameter greater than that of the female. The estimates made are based on the data of twenty cases of each sex selected from the entire list indiscriminately. It is of interest to note that in seventy of the male series there are found nine instances in which the diameter of the appendix is reported at five-sixteenths of an inch, and in all but one (89 per cent.) of the nine the appendix contained fecal matter, either hard or soft, principally the latter, or



FIG. 3. POSTERO-INFERIOR VIEW.—Showing (1) cecum covered with peritonæum on anterior and lateral surfaces only; (2) distal third of appendix enveloped with peritonæum, proximal two-thirds covered by peritonæum on anterior surface only, posterior surface extra-peritoneal; (3) appendix arising from end of cecum, continuous with perpendicular anterior band; pouching of cecum on either side. Contrast with fetal type (Fig. 4).

mucus. In some of these cases both of these substances were noted. In the exceptional case of this series the tube was entirely empty. In ten of the seventy cases the appendix was three-sixteenths of an inch in diameter, and of this number six (60 per cent.) contained fecal matter. Thinking that an increase in the size of the tube above the average implied the presence in it of faecal or other unnatural contents, in amounts proportionate to the increase in the diameter of the appendix, I examined the records of the contents of all those reported as one-fourth of an inch in diameter in seventy male cases, with the follow-

ing results: Of these seventy, there were found thirty-six, each being one-fourth of an inch in diameter; of the thirty-six, twenty-five (70 per cent.) contained faecal matter or mucus, and eleven were empty. According to this showing, the greater the diameter of the appendix, within apparently normal limits, the greater the probability of the presence in it of faecal or other matters. To recapitulate: In those appendices five-sixteenths of an inch in diameter eighty-nine per cent. contained faecal or other material; in those four-sixteenths of an inch in diameter nearly seventy per cent. contained similar products; in those three-sixteenths of an inch in diameter sixty per cent. were

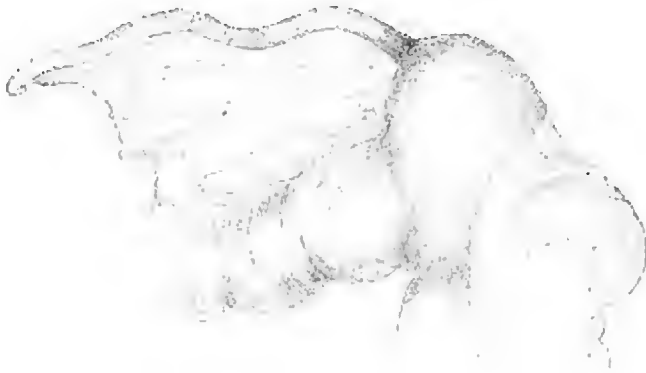


FIG. 4. ANTERIOR VIEW.—Showing (1) fetal type of caecum very small with appendix attached to extremity. Appendix is also very small, almost like a fibrous cord, and has a long, broad mesentery. Anterior band is not continued on to appendix.

invaded in a similar manner. A knowledge of these facts may enable one who happens to observe the appendix incidentally in the course of an operation, to take steps to obviate a subsequent danger by its removal when it shall appear greater than the average diameter. The average diameter of the human appendix is based on the examination of forty cases, irrespective of the presence in them or not of foreign matters, and it was found to be plus four-sixteenths of an inch. Of the forty cases there were twenty of each sex, and the average difference in the width of the appendices in the two sexes was, as before stated, one-tenth of an inch.

Thirty-nine instances were found in which the appendices were empty, and the measurements of each of these were given. In the male sex fifty-two per cent. were one-fourth of an inch in diameter, while in the female sex eighty-three per cent. were of this diameter. It is proper to say, however, that the entire number (39) is far too small a number upon which to base other than the following conclusions:

(1) That a greater number are empty, with a diameter of one-fourth of an inch, than are those of all other diameters combined. However, this is not strange, since the examples of the entire series having one-fourth inch diameter outnumber two to one those of other diameters, irrespective of the contents.



FIG. 5. ANTERIOR VIEW.—Showing large caecum, with appendix arising at inferior internal angle. Mesentery of appendix extends to its extremity.

(2) That those one-fourth of an inch diameter in the female sex are of proportionately much greater number (83 per cent.) than in the male. It is not strange that this disproportion should exist as to the empty appendix of the two sexes, since the appendices of the female are less liable to contain abnormal material than those of the male, as will be readily shown hereafter.

Contents of the Appendix.—One hundred and twenty-four of the entire series of cases (150) were examined with reference to

their contents. It is apparent at once that the importance of this phase of the subject cannot be considered to be secondary to any other, as the nature of the contents contribute largely to the ulcerative changes that lead to perforation of the appendix, and also to the gravity of the perforation itself. Of the 124 cases, eighty-two were of the male sex, thirty-four of the female sex, and in eighteen this distinctive item was not stated. Of the male series (82), fifty-eight (70 per cent.) contained abnormal matters of some kind, and twenty-four were entirely empty. Of the fifty-eight cases containing faecal, purulent and other matters, the

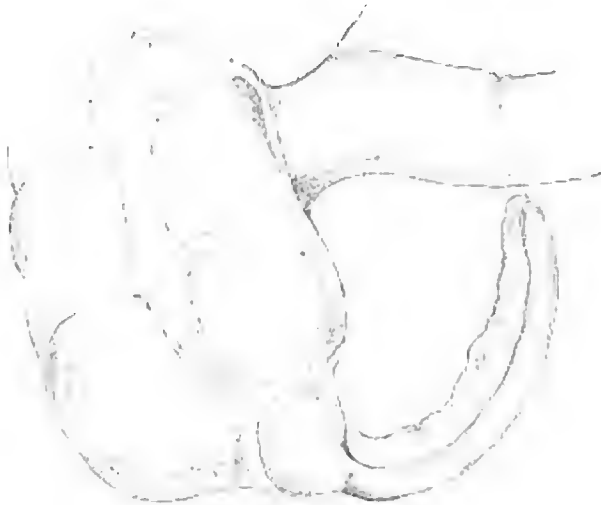


FIG. 6. ANTERIOR VIEW.—Showing rather large cecum with prominent muscular bands and appendix arising at nearly the middle of the extremity.

following statements will indicate the variety and also the percentage frequency of their presence: The presence of mucus in a greater or less amount was determined in fifteen instances (26 per cent.); mucus and faecal matter in five instances (about 10 per cent.); faecal matter alone in thirty, or nearly fifty-two per cent. of the cases. In several instances the faecal matter in these cases was hard, in one case approaching the size of a bean, in another somewhat smaller than this, but of equal consistency. Pus, faeces and mucus were present in one case, pus and faeces in one, pus

and fecus in two, gas and mucus in one, and pus alone in one. In the female series (34) fifteen, or nearly thirty-five per cent., were empty, while nineteen, or nearly fifty-six per cent., contained either mucus or faecal matter, and in some instances both. Seven, or about twenty per cent., contained mucus; twelve, or thirty-five per cent., contained faecal matter. Of the eighteen cases in which the sex was not indicated, eleven, or sixty-one per cent., were empty. The remaining seven cases of the eighteen showed that one contained mucus, five faecal matter, and one had undergone cystic degeneration at the extremity.



FIG. 7. ANTERIOR VIEW.—Showing cæcum forced forward and ilium entering from above. Appendix arises from interior lateral surface, posterior and a little below ilio-cæcal valve; it runs up parallel to ascending colon.

These figures illustrate the following important facts :

- (1) That sixty-seven per cent. of the entire series stated (124) contained abnormal material.
- (2) That abnormal material happens more frequently in the appendix of the male (70 per cent.) than of the female (56 per cent.).
- (3) That faecal matter, either soft or hard, is present more frequently in the vermiform, in both sexes, than any other class of matter, being noted in fifty-two per cent. of the male, and thirty-five per cent. of the female cases, and in twenty-eight per cent. of those in which the sex is not stated.

(4) That in no instance were there other than faecal substances, or products dependent on inflammation, present in these cases. Grape seeds and bodies foreign to the intestine were not found at all.

(5) That the presence of abnormal material in these cases (124) happened less frequently (67 per cent.) than is commonly ascribed to this condition.

Fitz, in his classical article "On Perforating Inflammation of the Vermiform Appendix," published in the *American Journal of Medical Sciences*, October, 1886, says: "In my own experience it is rather the rule than the exception for the appendix to contain moulded, more or less, inspissated faeces." If a comparison be now made between Matterstock's list of 169 fatal cases of perforating appendicitis, in which faecal concretions were present in fifty-three per cent. and foreign bodies in twelve per cent., it will be seen that the aggregate percentage (65) of such well-marked agents as appeared in Matterstock's list, must indicate the presence of additional matters of a soft nature, as mucus, pus, soft faeces, etc., which must have escaped appreciation in Matterstock's cases, owing to their intermingling with other disease products. The importance of the presence of inflammatory products in the appendix, in the absence of declared appendicular disease, is demonstrated by the results of Toft's post-mortem examinations, in which he found 110 instances of diseased appendix in 300 such examinations.

Relation of Age to Contents of Appendix.—The following tabulated statement plainly sets forth the association of these items in 102 cases, selected from the 150 already mentioned:

CONTENTS.	10 Years and under.	10 to 20 Years.	20 to 30 Years.	30 to 40 Years.	40 to 50 Years.	50 to 60 Years.	60 to 70 Years.	70 and Up- ward.	Totals.
Empty,	3	0	4	9	8	6	6	1	37
Fæces,	1	3	6	11	10	6	0	0	37
Mucus,	1	0	1	4	4	4	2	1	17
Mucus and fæces,			1	0	3	0	1		5
Mucus and pus,				1	0	0	0		1
Mucus and gas,					1	0	0		1
Pus,					1	0	0		1
Pus and fæces,					0	1	0		1
Enterolith,					1	0	0		1
Mucus, fæces and pus,							1		1
Total,	5	3	12	25	28	17	10	2	102

The percentage here (64) in 102 instances does not differ materially from the previous estimate (67), which was based on a little larger number of cases (124). In one instance the appendix of a six months' infant was found to be filled with soft fæcal matter. According to the preceding table the preponderance of appendicular tenantry appears to be present between the ages of 30 and 50 years, and a slight increase in favor of the latter decade is noticeable. Fitz's deductions demonstrate the fact that appendicitis happens most often between the ages of 10 and 30 years (66 per cent.); the first decade (38 per cent.) in this instance being more fruitful of disaster than the latter (22 per cent.). According to the same author appendicitis occurred in but twenty-three per cent. of those between 30 and 50 years of age in the first decade, of which fifteen per cent. of the total percentage happened. I am unwilling to attempt a reconciliation of the difference in time between the earlier occurrence of appendicitis in Fitz's cases, and the preponderance of later abnormalities of the appendix, as shown by the table just quoted.

Location, Direction and Extent of the Appendix.—(See illustrations.) The consideration of the location, direction and extent of the appendix is next in importance to the presence in it of abnormal matters, and of their character. One hundred and forty-four cases of the series (150) were examined to determine the above stated items of arrangement of the appendix. The influence of sex in the arrangement was considered as based on eighty-six male and forty female illustrations. In eighteen of the 144 cases the sex was not stated, and, therefore, these cases will not be mentioned except in a general manner.

The following tabulated statement offers complete and prompt opportunities to note the frequency of arrangement in both a general and comparative sense :

Appendix Directed.	Male.	Fe- male.	Not Stated.	Total.
Direction and extent of the appendix, as shown by autopsies of eighty-six male, forty female, and in eighteen cases in which sex is not stated.				
Inward,	20	11	3	34
Behind cæcum,	18	10	4	32
Downward and inward.	16	7	5	28
Into true pelvis,	14	3	4	21
Downward,	5	0	0	5
Upward and inward,	4	5	0	9
Upward and backward,	3	0	0	3
Upward and outward,	2	0	0	2
Outward,	1	1	0	2
Upward along inner side of colon to liver,	1	0	0	1
Upward outside of ascending colon and cæcum,	1	3	0	4
Curled below cæcum,	1	0	0	1
Downward and outward,	0	0	1	1
Upward and back of cæcum and colon,	0	0	1	1
Total,	86	40	18	144

Appendix Directed Inward.—It will be observed that the appendix is directed inward in plus twenty-four per cent. of the male, and plus twenty-seven per cent. of the female cases. If we now add to this expression of the position, "across the psoas, and toward the promontory of the sacrum," as is frequently done, the more exact extent and location of the appendix is defined. This modification aids in accounting for the nearer location to the median line of the body, in some cases, of the pain, tumor and tenderness of appendicitis, and also to associate more directly with this series of cases another series of 105 reported from the Russian (Turner) during the present year. Of the last series (105), twenty (19 per cent.) "extended transversely inward over the psoas and toward the promontory of the sacrum."

Appendix Behind the Cæcum.—It will be noticed that in the male series (86) the vermiform appendix was located behind the cæcum in the peritoneal cavity in a straight or curved manner eighteen times, or in about twenty per cent. of the cases; in the female series twenty times, or twenty-five per cent. of the cases; in the latter, or Russian series (105), it was located in a similar situation in about nine per cent. only. In the former series (145) it was thus placed in a little over twenty-two per cent., irrespective of sex. It is thus shown that the appendix is located behind the cæcum in American residents more than twice as frequently as in the Russian. It would be interesting, indeed, to observe, if any such comparative relation exists, regarding the symptoms of appendicitis in these nationalities. It is fair to assume, I think, that the pain, tenderness and tumor resulting from a diseased appendix located behind the cæcum are modified in an appreciable degree by the presence of that gut above and in front of it. A full inspiration should cause less pain if the diseased appendix be located here, since the sheltering influence is less disturbed than when formed by the more movable parts of the intestinal tract. Tenderness and tumor are less marked in these cases, because the distended and overlying cæcum makes difficult the detection of the latter, and ameliorates the severity of the former, on palpation. The morbid processes in these instances are more easily circumscribed than if the diseased appendix be less well

enviored, or be free in the abdominal cavity. It was my fortune last summer to see, while in consultation with my friend Dr. McGuire, of this city, a case of appendicitis aptly illustrating the sheltering influence of the cæcum. A full inspiration caused but little pain; the cæcum was markedly distended; pressure revealed no tumor then, although the lapse of time, the symptoms, and abdominal manifestations indicated a circumscribed process. Still a few hours after, on subsidence of the caecal tympanitis, a firm, tender, circumscribed and deep-seated tumor could be easily outlined at the bottom of an area previously occupied by the over-distended cæcum.

Appendix Directed into True Pelvis.—I esteem this position of the appendix as being one, if not the most important of the features of appendix location of the entire series. In eighty-six male cases the appendix entered the true pelvis in fourteen, or about fourteen per cent. of this series; in the forty female cases the pelvis was invaded in three instances, or in seven and a half per cent. It is apparent, therefore, that the male exhibits this peculiarity about twice as frequently as the female. This fact leads one to wonder whether or not the male sex suffers from pelvic appendicitis proportionately more frequently than the female. As the distance to which the appendix extended into the pelvis is not stated, it is not improbable that the difference in the lengths of this attachment in the sexes (4-10) may account for the greater number of pelvic extensions in the male sex. It should be noted that in the entire series (144), the appendix entered the true pelvis in about fourteen and a half per cent. of the cases, in one instance extending to midway between the base and apex of the sacrum. Strange to relate, in Turner's Russian series (105), before mentioned, fifty-one of the number are reported as extending into the pelvis. Of course, any accounting for this difference between the two races must be based largely on assumption, as it may be due to the fact that the appendix of the Russian is longer than that of the American. There appears to be some reason for this belief when it is considered that in the American series (144), the appendix was observed to run downward and inward toward the pelvis in twenty-eight instances, and to enter it

in twenty-one, making an aggregate of forty-nine, or a little over thirty-four per cent. of the cases. However, even now such a difference is present as to lead to the conclusion that the appendix of the Russian is longer, or that these observations cannot be relied upon in full. At all events, it would be interesting to know whether or not pelvic appendicitis is more common in Russia than in America, all other things being equal. It would be interesting, too, to be able to compute the relative frequency of pelvic involvement as compared to the other forms, in connection with the direction and extent of the vermiform in these respects. It is hardly necessary to direct attention to the salient clinical features of appendicular perforation within the pelvis. The pain, tenderness and tumor in these cases is nearer to the median line in front, and rectal examination often discloses the presence of heat, induration and abscess in the pelvis. Vesicular irritation, too, is a frequent concomitant. Here, surely, the gross anatomy has a close relationship to salient features of the clinical history.

It is rare, indeed, that the appendix can extend in either of the directions indicated in the tabulated statement without having a more or less close relation with the iliacus and psoas muscles, and the nervous cords so intimately connected with them, especially with the latter muscle. It naturally follows that the shorter the mesentery of the appendix the closer will be its relationship with the underlying tissue. Those appendices classed as "free" in the abdomen, are, therefore, farthest removable from these same structures. It sometimes happens that appendicitis is attended with pain in the thigh or testicles, due to direct or indirect involvement of the nerves supplying these parts. Flexion of the thigh often occurs early in the history of appendicular attacks, and the effort to extend the thigh is attended with pain in the pelvis, referable to the psoas or iliacus muscle. These muscles are often extensively, though infrequently, involved in the suppurative and destructive processes associated with an appendicitis. The pus incident thereto may point below Poupart's ligament, or, entering the pelvis, escape through the sacro-sciatic or obturator foramina. Now, one cannot speak consistently of all the rational clinical differences dependent on the anatomical relation of the

appendix, without danger of becoming verbose and tiresome, and it is not necessary, for the reason that this article is intended to be strongly suggestive and confirmatory, rather than assertive and encyclopædic.

I will not occupy farther time with this line of thought than is essential to call your attention to instances of rare arrangement of the appendix. In three of the 144 cases it was entirely extra-peritoneal; in five of this series each appendix was so bound down and covered by old inflammatory products as to lead one to judge at first the appendix to be extra-peritoneal. Of the Turner series (105) two were entirely extra-peritoneal, and four partly so. It requires no argument at this time to convince one that the clinical history of extra-peritoneal appendicitis must differ in pointed respects from the intra-peritoneal variety. Suffice it to say in this connection that obscure cases, characterized by dull, nagging pain in the abdomen, attended with hectic, emaciation and other symptoms suggestive of obscure suppuration, and malignant disease even, sometimes present themselves, and it is only after the escape of pus through some unusual channel, or at some unanticipated point, that the true nature of the disease is suspected. It has happened, too, that a carefully conducted autopsy was necessary to establish the true cause of the trouble. Appendicitis with these exhibitions has been mistaken for abscess of the liver, Psoas abscess, Pott's disease of the spine, necrosis, obscure tuberculosis, malignant disease and perinephritis, to say nothing of many other examples of mistaken diagnosis. It seems to me not improbable that in the majority of these cases of appendicitis the appendix was located external of the peritoneum at the outset. In one of the three cases of the extra-peritoneal series, the appendix extended upward back of the cæcum and colon; in another it ran upward along the inner border of the colon to the liver. The clinical history of the diseased appendix when thus located, and the ease of mistaking its true nature, can be readily conjectured.

Mesenteric Attachments of the Appendix.—(See illustrations). In sixty-six of 144 cases this feature of the arrangement was carefully noted; in twenty-six (40 per cent.) of the number (66), they

were characterized as " free " in that one-half or more of the length of the appendix was surrounded entirely by peritoneum. The remaining forty had mesenteries of various lengths, namely, four of about one inch in length ; eight of less than three-fourths of an inch ; and eighteen of above one inch in length.

The influence of a diseased appendix, when it is free in the abdominal cavity, on the clinical history and progress of the case, is often illustrated by the severity of the attacks, the rapid super-vention and extension of disease, and unfortunately, too, by the hurried demise of the patient in the absence of prompt surgical relief. According to my own observation, gangrenous appendicitis happens more frequently with the " free " arrangement of the appendix than with all of the other forms combined, and, too, the gangrenous manifestations have appeared at or beyond the outer limit of mesenteric attachment. The pathological venom of a freely movable diseased appendix is distributed over a greater area than that of a less freely movable one. The respiratory acts, the efforts of vomiting, and the vermicular movements of the contiguous intestines, contribute largely to this unfortunate result.

In conclusion, permit me to express the hope that you have not been unduly fatigued by this effort of mine to show through the foregoing illustrations, *first*, that abstract anatomy alone has little practical utility in medicine or surgery ; *second*, that there is a very important relationship existing between the gross anatomy of the vermiform appendix and some features of the clinical history of appendicitis.